

REMARKS

Examiner M. Guerrero is thanked for the thorough examination and search of the subject Patent Application. Claims 1, 6, and 14 have been amended. No new matter has been added.

All Claims are believed to be in condition for Allowance, and that is so requested.

Reconsideration of the rejection under U.S.C. 112, second paragraph of claims 1-12, 14-19, and 26-27 is requested in view of amended claims 1, 6, and, 14. Claims 1, 6, and 14 have been amended to refer to the “bulk silicon substrate” rather than “bulk silicon layer”. The Examiner is thanked for finding this typographical error.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 1, 3, 5-7, 9, 11-12, 14, 16, 18-19, and 26-27 as being rejected over Mansoori et al in view of Yeo et al is requested in accordance with the following remarks.

Applicants' halo implants 30 extend downward through the epitaxial silicon layer 14 to the interface of the epitaxial silicon layer with the carbon-doped layer, as shown in Fig. 3. It is critical that the carbon-doped layer 12 lies at the silicon interface of the halo doping profile (page 9) to prevent end-of-range secondary defects associated with the halo implant. See the top of page 10 where it is stated that ideally the halo implants will be formed to the depth of the carbon-doped layer. In Applicants' invention, the carbon-doped layer is intentionally directed away from the transistor channel region. This is to avoid undesirable electrical effects which may

result from the presence of carbon in the transistor channel. Due to processing and fundamental concerns, carbon may exist in the form of interstitials in silicon and this degrades the drive current of the transistor when located nearer to the channel region. Another purpose of partially overlapping the implant profile is in order to conserve the usual dopant activation scheme. This is to simplify the fabrication of the transistor such that the dopant activation kinetics in silicon, which has been well understood, may be applicable.

Mansoori's halo implants 152 (Fig. 15) are implanted within the carbon-doped layer 104, not within the epitaxial silicon layer 108. Thus, the location of the carbon-doped layer beginning at the end-of-range of the halo implant doping profile is not taught by Mansoori et al. Mansoori et al's halo implants 152 are not formed to the depth of the carbon-doped layer, but to a greater depth than the carbon-doped layer. No details of the halo implant are provided. Heavy ions for the halo implant are not disclosed in Mansoori et al.

It is agreed that Yeo et al shows source and drain regions extending into the bulk silicon substrate. However, it is not agreed that there would be motivation to combine Yeo et al with Mansoori et al. Yeo et al provides a strained channel silicon-germanium-carbon layer. This layer can be formed by epitaxial growth of silicon-germanium followed by carbon doping of the layer (col. 3, lines 56-62). The paragraph bridging pages 8 and 9 of the Specification discusses the drawbacks of carbon-doping by ion implantation.

In conclusion, the combination of the location of the halo implants within the epitaxial silicon layer and extending downward through the epitaxial silicon layer to an interface between

the epitaxial silicon layer and the carbon-doped silicon layer and the location of the source and drain regions within the epitaxial silicon layer and extending through the carbon-doped silicon layer into the bulk silicon substrate is not taught or suggested by Mansoori et al and Yeo et al.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 1, 3, 5-7, 9, 11-12, 14, 16, 18-19, and 26-27 as being unpatentable over Mansoori et al in view of Yeo et al is requested in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 2, 4, 8, 10, 15, and 17 as being unpatentable over Mansoori et al and Yeo et al and further in view of Takahashi is requested in accordance with the following remarks.

Takahashi shows depositing a carbon-containing polycrystalline layer. Since Takahashi's carbon-doped layer is deposited on a polycrystalline silicon layer, it will be polycrystalline in structure, rather than monocrystalline as are the layers of Mansoori et al and the Applicants' invention. Also, Takahashi's layer is used to prevent thermal diffusion "solely on the polycrystalline silicon layer 22" underlying the carbon-containing layer 24 (col. 5, lines 62-67). The carbon-containing layer 24 becomes part of a gate electrode as shown in Fig. 3. This has nothing to do with Applicants' invention or with Mansoori et al. While it is agreed that Takahashi teaches depositing a carbon-doped silicon layer by reduced pressure vapor deposition, it is not agreed that there would be any motivation to combine Takahashi with Mansoori et al because their carbon-doped layers are used for entirely different purposes and the crystal structure and location of the carbon layers are different. Since Takahashi's carbon-doped layer is

deposited on a polycrystalline silicon layer, it will be polycrystalline in structure, rather than monocrystalline as are the layers of Mansoori et al and the Applicants' invention. Furthermore, Mansoori et al teaches that the carbon-containing layer may be formed by any technique including implanting carbon in the wafer or growing a carbon-containing layer over the semiconductor body. Yeo et al also teaches that the silicon-germanium-carbon layer can be formed by implanting carbon into the silicon-germanium layer. This teaches away from Applicants' invention since Applicants have found that implanting carbon can cause damage at the tail end of the implantation profile (see the discussion in the paragraph bridging pages 8 and 9). Thus, Applicants' invention is not taught or suggested by the combination of references.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 2, 4, 8, 10, 15, and 17 as being unpatentable over Mansoori et al and Yeo et al and further in view of Takahashi is requested in accordance with the remarks above.

Allowance of all Claims is requested.

It is requested that should Examiner Guerrero not find that the Claims are now Allowable that the Examiner call the undersigned at 765 4530866 to overcome any problems preventing allowance.

Respectfully submitted,


Rosemary L. S. Pike
Reg # 39,332